Effect of location on out-of-hospital cardiac arrests involving older adults in Hong Kong: secondary analysis of a territory-wide cohort

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ABSTRACT

Introduction: Most out-of-hospital cardiac arrests in Hong Kong involve older adults. The likelihood of survival varies among locations. This study investigated patient and bystander characteristics, as well as the timing of interventions, that affect the prevalences of shockable rhythm and survival outcomes among cardiac arrests involving older adults in homes, on streets, and in other public places.

Methods: This secondary analysis of a territory-wide historical cohort used data collected by the Fire Services Department of Hong Kong from 1 August 2012 to 31 July 2013.

Results: Bystander cardiopulmonary resuscitation was primarily performed by relatives in homes but not in non-residential locations. The intervals in terms of receipt of emergency medical services (EMS) call, initiation of bystander cardiopulmonary resuscitation, and receipt of defibrillation were longer for cardiac arrests that occurred in homes. The median interval for EMS to reach patients was 3 minutes longer in homes than on streets (P<0.001). Forty-seven percent of patients who developed cardiac arrest on streets had a shockable rhythm within the first 5 minutes after receipt of EMS call. Defibrillation within 15 minutes after receipt of EMS call was an independent predictor of 30-day survival (odds ratio=4.07; P=0.02). Fifty percent of patients who received defibrillation within 5 minutes in non-residential locations survived.

Conclusion: There were significant location-related differences in patient and bystander characteristics, interventions, and outcomes among cardiac arrests involving older adults. A large proportion of patients had a shockable rhythm in the early period after cardiac arrest. Good survival outcomes in out-of-hospital cardiac arrests involving older adults can be achieved through early bystander defibrillation and intervention.

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New knowledge added by this study

- Among out-of-hospital cardiac arrests involving older adults that occurred at different locations, there were significant differences in patient and bystander characteristics, as well as prehospital interventions, which influenced survival outcomes.
- Many older adults who experienced cardiac arrest in non-residential locations had a shockable rhythm in the early period after receipt of emergency medical services (EMS) call, and early defibrillation was associated with favourable survival outcomes.
- Low rates of shockable rhythm and significant delays in bystander and EMS processes were observed within homes.

Implications for clinical practice or policy

- Additional measures are needed to overcome bystander inertia.
- Interventions to mitigate the adverse factors related to cardiac arrests occurring in older adult households, such as volunteer dispatch via mobile applications, should be considered.

Introduction

The proportion of older adults in Hong Kong is expected to increase from 18% in 2019 to 26% by the year 2029.[1] Overcrowding is a serious problem, such that population densities of 57 530 people/km^2 are present in ageing districts.[2,3] Most residents of Hong Kong live in high-rise apartments that require elevators for access, but most elevators cannot accommodate an ambulance stretcher with a patient in a supine position.[4] More than 50% of out-of-hospital cardiac arrest (OHCA) events occur in private homes, a location that is associated with poor survival outcomes.[5] The proportion of domestic households consisting solely of people aged ≥65 years has increased by approximately 24% between 2011 and 2016, from 8.4% to 10.4%.[6] Considering these demographic changes, there is a need for improved overall understanding of the prehospital management of cardiac arrests that involve older adults in homes and other locations.

This study investigated patient characteristics, types of bystanders involved, and prehospital interventions that were associated with differences in survival outcomes among cardiac arrests involving older adults in homes, compared with cardiac arrests on streets and in public areas excluding streets (PAES).

Methods

Study design and setting

This secondary analysis focused on a historical cohort from a previous study.[5] The Emergency Ambulance Service of the Fire Services Department (FSD) provides most emergency medical services (EMS) in Hong Kong through a one-tiered system that serves the entire 1104 km^2 region. At the time of data collection, the population was around 7.1 million.[7] Ambulance personnel are required to perform cardiopulmonary resuscitation (CPR) on and transfer most cases of OHCA to hospitals. A small number of patients with obvious post-mortem changes (eg, rigor mortis) may be directly transferred to the public mortuary; such patients were not included in this study. Fire Services Department ambulances will only transfer patients to emergency departments under the Hospital Authority. At the time of data collection, callers requesting for EMS for OHCA patients were not provided with post-dispatch instructions to perform CPR.

Participants

This secondary analysis included all patients with OHCA who were transferred to the Emergency Departments (EDs) by FSD ground ambulances from 1 August 2012 to 31 July 2013. Exclusion criteria were cardiac arrests caused by trauma, patients not transferred by ground ambulance, and patients directly transferred to the public mortuary. After patient selection from the primary dataset, the following additional exclusions were made: cardiac arrests that involved patients aged <65 years, occurred within residential care homes for the elderly, or occurred in the ambulance en route to hospital.

Data sources

Data regarding patient characteristics and prehospital management were prospectively collected by EMS personnel who were directly involved in prehospital care for patients who experienced OHCA. The collected data included patient age and sex, location of cardiac arrest, whether the cardiac arrest was witnessed and the identity of the witness, whether bystander CPR was performed and who performed it, whether defibrillation with an automated external defibrillator (AED) was performed, what electrocardiogram rhythm was first detected, the timings of prehospital events (recognition of cardiac arrest, receipt of EMS call, initiation of bystander CPR, initiation of first defibrillation, EMS arrival at patient's side, initiation of CPR by EMS personnel, and arrival at the ED), and return of spontaneous circulation (ROSC) before ED arrival.

Electronic medical records at the relevant ED (Accident and Emergency Information System, Hong Kong Hospital Authority) were reviewed to determine the time of defibrillation and time of ROSC at the ED, as well as whether a patient survived until admission. A patient was assumed to have received no resuscitative intervention unless specific documentation was present in the ED record. Neurological status upon discharge and survival at 30 days after cardiac arrest were determined from a territory-wide electronic medical record database (Clinical Management System, Hong Kong Hospital Authority).

Variables

Streets were defined as paved thoroughfares for pedestrians, including sidewalks. Public areas excluding streets were other areas that were accessible by the public throughout the day; these included outdoors (eg, parks and markets) and indoor facilities (eg, eateries, places of recreation, and day care facilities for older adults). Bystanders were defined in accordance with the guidelines of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest.[8] Fire Services Department first responders dispatched to the scene were classified as EMS personnel. Older adult

位置對涉及香港老年人的院外心臟驟停的影響：對全港隊列的二次分析

黃達銘

引言：香港大多數院外心臟驟停涉及老年人。生存的可能性因地點而異。本研究調查涉及老年人在家中、街道和其他公共場所出現心臟驟停時患者和旁觀者的特徵以及干預的時機、可電擊心律的發生率和存活率。

方法：這項研究使用香港消防處於2012年8月1日至2013年7月31日收集的全港性數據進行二次分析。

結果：在家中出現心臟驟停時旁觀者心肺復蘇主要由親屬進行。對於在家中發生的心臟驟停，有關部門接獲緊急醫療服務求助電話、啟動旁觀者心肺復蘇和患者接受除顫所需的時間更長。緊急醫療服務到達患者的中位間隔時間在家中比在街道上長3分鐘。在街頭發生心臟驟停的患者中，47%在緊急醫療服務求助電話接獲後5分鐘內都有可電擊心律。緊急醫療服務求助電話接獲後15分鐘內除顫是30天生存的獨立預測指標（勝算比=4.07；P=0.02）。在非住宅地點5分鐘內接受除顫的患者的存活率為50%。

結論：在涉及老年人的心臟驟停中，患者和旁觀者的特徵、干預措施和結果存在顯著的位置相關差異。大部分患者在心臟驟停的初期都出現可電擊心律。對於涉及老年人的院外心臟驟停來説，由旁觀者及早進行除顫及干預措施有助造成良好的存活結果。

care workers (OACWs) are individuals who care for residents in various private and public housing arrangements for older adults. Older adult care workers accompanying patients were not dispatched as part of the organised emergency rescue team; thus, they were classified as bystanders. Public access defibrillation (PAD) was defined as a defibrillation shock delivered from an AED when a bystander performed CPR. Shocks delivered when FSD first responders performed CPR were excluded.

Time intervals were rounded to the nearest minute. The decision interval was the interval between recognition of cardiac arrest and receipt of EMS call. Call-to-bystander CPR was the interval between receipt of EMS call and initiation of bystander CPR. Call-to-EMS arrival was the interval between receipt of EMS call and EMS arrival at the patient's side. Time of first defibrillation was defined as the time of the earliest of the following three events: PAD, defibrillation by EMS, or defibrillation in the ED. Call-to-bystander CPR intervals were grouped as 0-2, 3-5, 6-8, 9-11, and 12-31 minutes, as well as no bystander CPR. Call-to-first defibrillation intervals were grouped as 0-5, 6-10, 11-15, 16-20, and 21-55 minutes, as well as no defibrillation (>55 minutes/not applicable).

Post-cardiac arrest neurological status was classified using the 5-point Glasgow-Pittsburgh Cerebral Performance Categories (CPC) scale. In the scale, CPC 1 represents patients with good cerebral performance; CPC 2 includes patients who can manage activities of daily living independently or participate in part-time work in a sheltered environment; CPC 3 to CPC 5 ranges from patients who are unable to live independently because of cerebral disability to patients who have experienced brain death. Patients with CPC 1 or CPC 2 were presumed to have a favourable neurological outcome.

Statistical methods

Patient characteristics, interventions, and outcomes were analysed using descriptive statistics. Pearson's χ^2 test was used to compare categorical variables; Fisher's exact test was used if >20% of expected counts were <5. The Kruskal–Wallis rank sum test was used to compare non-parametric time intervals. A P value of <0.05 was considered statistically significant. Predictors of 30-day survival were analysed using univariate and multivariate logistic regression; findings were reported as odds ratios (ORs) with 95% confidence intervals. Adjusted variables included age; sex; arrest location; person witnessing the arrest (relative, OACW or other bystanders, EMS personnel, or unwitnessed); person performing bystander CPR (no bystander CPR, OACW, relative, or other); PAD (yes or no); first monitored rhythm (asystole, pulseless electrical activity, or ventricular fibrillation/ventricular tachycardia); and call-to-EMS arrival, call-to-bystander CPR, and call-to-first defibrillation intervals.

Statistical analysis was performed using R software, version 3.6.1 (R Foundation for Statistical Computing, Austria). The original study was approved by the Institutional Review Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster (Ref No.: UW 15-599). No new data were collected for secondary analysis. This manuscript was prepared in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines.

Results

Participant selection and characteristics

Figure 1 describes patient selection from the primary dataset. The original cohort comprised 5154 patients with OHCA who were transferred to the ED by FSD ground ambulances. After the application of exclusion criteria, 2255 patients were included in the analysis. Table 1 compares the patient and bystander characteristics, interventions, and outcomes of OHCA occurring in homes, in PAES, and on streets. Patients who experienced cardiac arrest in homes were significantly older (approximately 5 years; P<0.001) than patients who experienced cardiac arrest on streets or in PAES. In all groups, there were more male patients; the sex disparity was the greatest in the streets group, followed by the PAES group.

Furthermore, most cardiac arrests (66.4% among all patients; P<0.001; Table 1) were unwitnessed. Relatives were the most common type

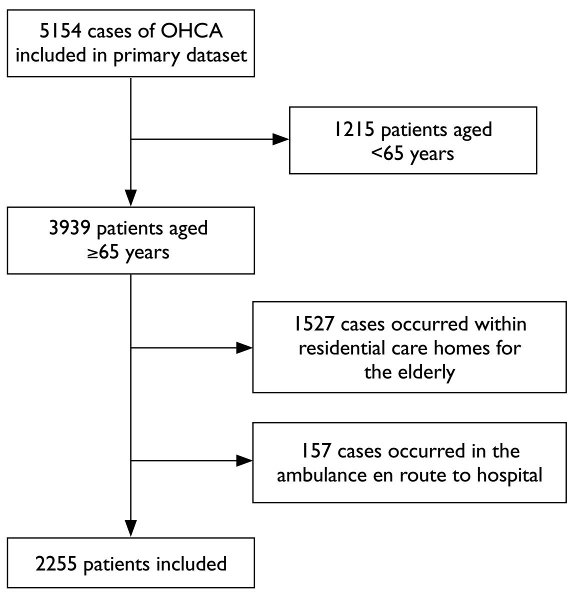

FIG 1. Patient selection from primary dataset
Abbreviation: OHCA = out-of-hospital cardiac arrest

TABLE 1. Patient and bystander characteristics, interventions, and survival outcomes of out-of-hospital cardiac arrests involving older adults in homes, on streets, and in other public areas*

	Overall	Homes	PAES	Streets	P value
No. of patients	2255	1971	207	77	
Age, y	81.2 ± 8.3	81.8 ± 8.2	76.9 ±8.1	76.6 ±7.1	<0.001†
Sex					<0.001‡
Male	1240 (55.0%)	1041 (52.8%)	143 (69.1%)	56 (72.7%)	
Female	1015 (45.0%)	930 (47.2%)	64 (30.9%)	21 (27.3%)	
Bystander witnessed					<0.001§
Relative	538 (23.9%)	492 (25.0%)	35 (16.9%)	11 (14.3%)	
OACW	36 (1.6%)	11 (0.6%)	23 (11.1%)	2 (2.6%)	
Other‖	80 (3.5%)	48 (2.4%)	23 (11.1%)	9 (11.7%)	
EMS personnel witnessed¶	104 (4.6%)	83 (4.2%)	14 (6.8%)	7 (9.1%)	0.2‡
Unwitnessed	1497 (66.4%)	1337 (67.8%)	112 (54.1%)	48 (62.3%)	<0.001‡
Bystander CPR	123 (5.5%)	75 (3.8%)	41 (19.8%)	7 (9.1%)	<0.001‡
PAD (% of VF/VT)	9 (4.7%)	2 (1.8%)	7 (14.9%)	0	0.002§
First monitored rhythm					<0.001‡
Asystole	1832 (81.2%)	1666 (84.5%)	132 (63.8%)	34 (44.2%)	
PEA	233 (10.3%)	191 (9.7%)	28 (13.5%)	14 (18.2%)	
VF/VT	190 (8.4%)	114 (5.8%)	47 (22.7%)	29 (37.7%)	
Decision interval, min	0 (0-3)	0 (0-4)	0 (0-1)	0 (0-2)	<0.001†
Call-to-bystander CPR, min	8 (5-10)	8 (6-10)	5 (0-8)	2.5 (-0.25 to 5)	<0.001†
Call-to-first defibrillation, min	12 (10-18)	14 (11-20)	10 (8.5-11)	10 (9-13)	<0.001†
Call-to-EMS arrival, min	10 (8-12)	10 (8-12)	9 (7-12)	7 (6-10)	<0.001†
ROSC	73 (3.2%)	45 (2.3%)	20 (9.7%)	8 (10.4%)	<0.001‡
Survival at 30 days, No. of patients	37 (1.6%)	17 (0.9%)	17 (8.2%)	3 (3.9%)	<0.001§
CPC ≤2**	19 (0.8%)	6 (0.3%)	10 (4.8%)	3 (3.9%)	<0.001§

Abbreviations: CPC = Glasgow-Pittsburgh Cerebral Performance Category; CPR = cardiopulmonary resuscitation; EMS = emergency medical service; OACW = older adult care worker; PAD = public access defibrillation; PAES = public areas excluding streets; PEA = pulseless electrical activity; ROSC = return of spontaneous circulation; VF/VT = ventricular fibrillation/ventricular tachycardia

* Data are shown as No. (%), mean ± standard deviation, or median (interquartile range)

† Kruskal–Wallis test comparing homes, streets, and other public areas

‡ Chi squared test comparing homes, streets, and other public areas

§ Fisher's exact test comparing homes, streets, and other public areas

‖ Includes domestic workers, friends, and unclassified individuals

¶ Includes Fire Services Department ambulance personnel and first responders responding as part of the organised emergency response team

** Patients classified as CPC ≤2 can manage activities of daily living independently or participate in part-time work in a sheltered environment

of bystander present in witnessed arrests, whereas there were significant differences in the involvement of OACWs, EMS personnel, and other individuals at the three locations. Compared with EMS personnel, there were more OACWs as bystanders in PAES and more bystanders, represented by the 'other' group, in PAES and on streets. There was a significant difference in the proportion of bystanders performing CPR among the three locations (P<0.001), as illustrated in Figure 2. The bystander CPR rate was the highest in PAES and the lowest in homes. Among the nine patients who received PAD, six received it when OACWs provided CPR in PAES.

Initial monitored rhythm

Notably, asystole was the most common initial monitored rhythm (81.2% among all patients; P<0.001; Table 1). However, cardiac arrests on streets and in PAES had significantly higher rates of shockable rhythm and PEA, compared with cardiac arrests in homes. The prevalences of shockable rhythm relative to the time from receipt of EMS call and the location of cardiac arrest are shown in Figure 3. The highest rates of shockable initial rhythm (SIR) were observed within the first 5 and 10 minutes after receipt of EMS call for cardiac arrests on streets, which were 47% (8/17) and 41% (17/42), respectively.

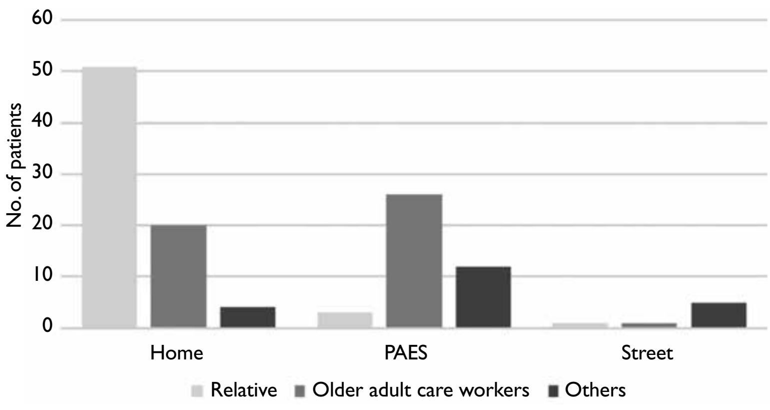

FIG 2. Identity of bystanders performing cardiopulmonary resuscitation in homes, in public areas excluding streets (PAES), and on streets

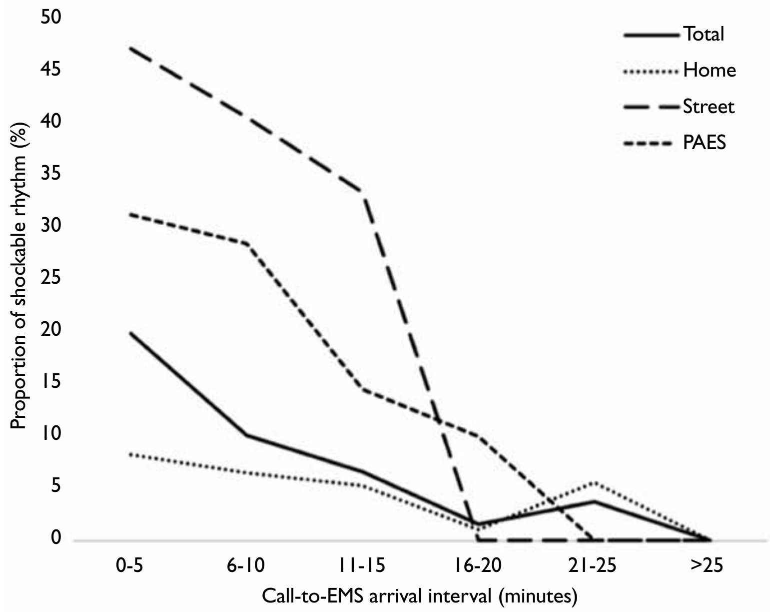

FIG 3. Location, time from receipt of emergency medical services (EMS) call, and proportion of shockable rhythm of cardiac arrests
Abbreviation: PAES = public areas excluding streets

Timing of interventions

Patients with cardiac arrest in homes had significantly longer intervals in terms of receipt of EMS call, initiation of bystander CPR, and receipt of defibrillation (all P<0.001; Table 1). The median interval for EMS to reach patients was 3 minutes longer in homes than on streets. The interval between recognition of cardiac arrest and receipt of EMS call was 0 minutes in 57.5% of patients (1297/2255).

Survival and neurological outcomes

Additionally, patients with cardiac arrest in homes had significantly lower rates of ROSC, 30-day survival, and favourable neurological outcomes (all P<0.001; Table 1).

Independent predictors of 30-day survival are shown in Table 2. Older age and longer call-to-EMS arrival interval both decreased the overall likelihood of survival (ORs of 0.92 and 0.87, respectively). Pulseless electrical activity and ventricular fibrillation/ventricular tachycardia increased the likelihood of survival compared with asystole (ORs of 6.4 and 15.6, respectively). Cardiac arrest witnessed by EMS personnel and defibrillation within 15 minutes after receipt of EMS call increased the overall likelihood of survival (ORs of 6.23 and 4.07, respectively).

The relationship among the location, timing of defibrillation, and 30-day survival of cardiac arrest is shown in Figure 4. Overall, patients who received defibrillation within 5 minutes and at 6 to 10 minutes after receipt of EMS call had survival rates of 33% (2/6) and 17% (15/86), respectively. For patients who received defibrillation on streets/in PAES within 5 minutes and at 6 to 10 minutes after receipt of EMS call, the survival rates were 50% (2/4) and 22% (10/45), respectively. Two patients in the homes group received defibrillation within 5 minutes; the survival rate was 0% (0/2).

Cardiac arrest at home was a predictor of survival in univariate analysis (OR=0.076, 95% confidence interval [CI]=0.038-0.15) but not in multivariable analysis (OR=0.65, 95% CI=0.22-1.90). The effect of location on survival was mediated by the first monitored rhythm, and the call-to-EMS arrival interval.

Discussion

This study investigated factors that affect the prevalences of shockable rhythm and survival outcomes among cardiac arrests involving older adults in Hong Kong. The patient characteristics, proportion of witnessed arrests, and rates of SIR and PAD for cardiac arrests involving older adults in homes were similar between the present study and a previous analysis in Japan.[9] Unlike many western countries, EMS personnel in Hong Kong and Japan generally do not terminate resuscitation in the field; this similarity facilitates comparison of data between the two studies. A notable difference was that in Japanese homes, 45% of older patients received bystander CPR; this receipt of CPR was associated with rate of ROSC, 30-day survival, and favourable neurological outcomes that were threefold higher than the corresponding rates in Hong Kong.

Bystander cardiopulmonary resuscitation

The bystander CPR rate in Hong Kong homes was low (3.8%) [Table 1], and there was a substantial delay in its initiation. Although the type of relatives involved as bystanders was not recorded in the present study, considering the proportion of older adult households in Hong Kong,[6] many of the relatives presumably were cohabiting older adults. Such individuals may not be able to follow telephone instructions to perform CPR because of physical limitations or emotional distress[10]; thus, the provision of post-dispatch instructions and enhancement of community-wide CPR training will not improve survival among these patients.[11] Although high-rise apartments create barriers to EMS personnel, they also increase the likelihood that trained volunteers will be present in the vicinity, where they may be dispatched using mobile applications.[12-14]

In non-residential locations, most bystanders performing CPR were not relatives of the patients. Fear of legal consequences is reportedly a major cause for intervention inertia in this situation.[15] A previous survey in Hong Kong, in which one-third of respondents had prior first aid training, revealed that nearly all respondents were willing to call for help but only one-fifth were willing to perform bystander CPR.[16] These findings suggest that knowledge transfer is insufficient to overcome bystander inertia in Hong Kong. Training programmes should ensure that factors inhibiting intervention (eg, legal concerns, fear of disease transmission, and bystander effect) are addressed.[17,18]

Shockable initial rhythm

Previous studies in Hong Kong revealed low rates of SIR in patients with OHCA, ranging from 5% to 14%, along with dismal survival rates of 0.6% to 3%.[1,19,20] These low rates imply that aggressive bystander interventions (eg, defibrillation for older adults) are futile. However, the findings of the present study indicate that older adults in non-residential locations have much higher SIR rates in the initial 10 minutes after receipt of EMS call; moreover, early defibrillation is an independent predictor of survival among such patients, and high survival rates can be achieved with early defibrillation.

The present study revealed a 2% per-minute decrease in the rate of SIR. This is similar to the findings in a large multinational study from northern Europe.[21] Differences in SIR rates between residential and non-residential locations may be partly related to patient factors (eg, age and presence of co-morbidities); they could also be related to differences in the decision interval (ie, time elapsed between recognition of cardiac arrest [as reported by a bystander] and receipt of EMS call). A previous study in Hong Kong showed that efforts to seek advice from relatives often contributed to delayed receipt of EMS call.[4] Longer decision intervals and consequential delays in EMS arrival lead to interactions with later parts of the shockable rhythm downslope and lower SIR rates. In practice, the recall of decision intervals by bystanders is unreliable. This is consistent with the decision interval of 0 minutes reported by most bystanders in the present study. Despite this confounding factor, the findings in this study indicate that bystanders should not hesitate to provide aggressive resuscitation and early defibrillation for older patients.

TABLE 2. Independent predictors of 30-day survival of cardiac arrests

	Odds ratio	95% Confidence interval	P value
Age	0.92	0.87-0.96	<0.001
Arrest witnessed by ambulance personnel*	6.23	1.98-19.6	<0.01
Initial rhythm PEA†	6.4	2.3-17.8	<0.001
Initial rhythm VF/VT†	15.6	1.99-123	<0.01
Call-to-EMS arrival interval	0.87	0.76-0.98	0.03
Call-to-first defibrillation ≤15 minutes‡	4.07	1.23-13.4	0.02

Abbreviations: EMS = emergency medical services; PEA = pulseless electrical activity; VF/VT = ventricular fibrillation/ventricular tachycardia

* Unwitnessed arrests as reference group

† Asystole as reference group

‡ Call-to-first defibrillation 16-55 minutes as reference group

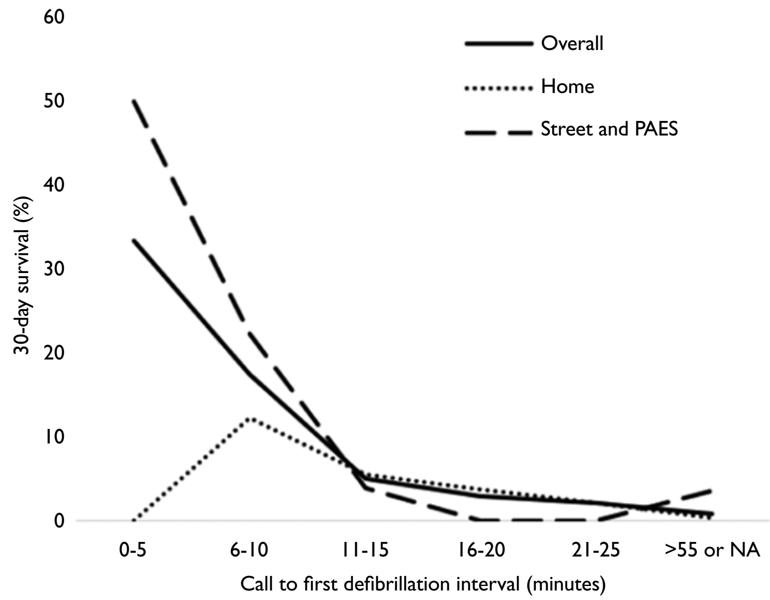

FIG 4. Relationship among location, timing of defibrillation, and survival of cardiac arrests. Only two patients in the home group received defibrillation within 5 minutes. Streets and public areas excluding streets are combined because of the small number of patients in some subgroups

Abbreviations: NA = not applicable; PAES = public areas excluding streets

Public access defibrillation

Notably, very few patients received PAD in this study, and most instances of PAD administration were performed by OACWs in PAES. According to a nationwide study in Japan, 16.5% of patients received PAD during witnessed ventricular fibrillation cardiac arrest.[22] Estimation of the AED coverage rate in Hong Kong using a horizontal level walking route distance model revealed that only 11% of patients with OHCA would have an AED within 100 m.[23] Considering the large number of OHCA events occurring within high-rise buildings, the actual coverage rate is presumably lower. Furthermore, there is evidence that most people in Hong Kong do not know the location of the AED nearest to their home or workplace.[16] Unless AEDs are easy to locate and readily accessible at all times, PAD rates will remain low.[24]

Barriers to rescue in high-rise buildings

In a previous study in Hong Kong, the proportions of patients with OHCA who could be accessed by elevator or stairs and by stairs alone were 74% and 14%, respectively.[4] In the present study, the median interval for EMS to reach patients was 3 minutes longer in homes than on streets. This represents the 'vertical response time' component of the call-to-EMS arrival interval.[25] In a previous study, survival was lower among patients who experienced cardiac arrest at higher levels within buildings.[26] Nearly 70% of lifts in Hong Kong do not have sufficient area to accommodate the ambulance stretcher.[4] Therefore, the vertical response time leads to a delay in EMS interventions and deterioration in CPR quality, both of which may contribute to the poor outcomes of cardiac arrests that occur in homes. The use of circulatory adjuncts to enhance cerebral perfusion during head-up position CPR within lifts should be considered.[27]

Limitations

Importantly, only patients transported to hospital by FSD ground ambulances were included in this study; a small number of patients with OHCA may have been transported to hospital by other means.

Furthermore, data regarding the timings of recognition of cardiac arrest, bystander CPR, and PAD obtained from bystanders may have been subject to response bias. The lack of blinding of emergency department personnel towards patient factors (eg, absence of shockable rhythm and prehospital defibrillation, longer time to ROSC, co-morbidities, and advanced age) may have led to selection bias regarding treatment decisions, including the termination of resuscitation, arrangement of intensive care unit resources, and coronary angiography; such bias has been reported to negatively influence the survival rate.[28] Data regarding pre-arrest co-morbidity and functional status were not available, which may have resulted in a confounding effect on survival outcomes. Additionally, a small number of patients received defibrillation within 5 minutes. All of the factors listed here may have affected the accuracy of conclusions drawn from this subset.

This study was based on territory-wide data collected in 2012 to 2013. Thus, it may not reflect the current situation because of changes in patient demography, prevalence of shockable rhythm, and survival enhancement interventions introduced in the past several years. A large multinational study in northern Europe investigated the rate of SIR among OHCA events occurring in residential and public locations from 2006 to 2015. The rate of SIR in public locations remained stable during that period. A decrease was observed in residential locations between 2006 and 2010, but the proportion has remained stable since 2011.[21] Therefore, despite these limitations, the findings of the present study add to the broader understanding of OHCA involving older adults.

Conclusion

This study revealed significant differences in the patient and bystander characteristics and prehospital interventions among cardiac arrests involving older adults that occurred in homes, on streets, and in other public locations. Many older adults who experienced cardiac arrest in non-residential locations had a shockable rhythm in the early period after receipt of EMS call. Early defibrillation, an independent predictor of survival, was associated with favourable survival outcomes in older adults. These findings suggest that bystanders should provide aggressive resuscitation, including early defibrillation. Additionally, low rates of shockable rhythm and significant delays in bystander and EMS processes were observed within homes. New interventions (eg, volunteer dispatch via mobile applications) are needed to overcome unfavourable factors that affect cardiac arrests occurring within older adult households. Finally, the overall bystander CPR rate was low, indicating that additional measures are needed to overcome bystander inertia. The insights from this study will help to improve survival outcomes in OHCAs involving older adults.

Author contributions

The author contributed to the concept or design, analysis or interpretation of data, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. The author had full access to the data, contributed to the study, approved the final version for publication, and takes responsibility for its accuracy and integrity.

Conflicts of interest

The author has no conflicts of interest to disclose.

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Ethics approval

This study is a secondary analysis of a historical cohort study which was approved by the Institutional Review Board of The University of Hong Kong/Hospital Authority Hong Kong West Cluster (Ref No.: UW 15-599). The requirement for informed patient consent was waived because of the retrospective study design. All patient data in the dataset were anonymous.

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